

Acanthocephala, including the descriptions of two new species of *Mediorhynchus* (Gigantorhynchidae) from birds from Paraguay, South America

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Acanthocephala, including the descriptions of two new species of *Mediorhynchus* (Gigantorhynchidae) from birds from Paraguay, South America. - *Mediorhynchus emberizae* (Rudolphi, 1819), *M. micracanthus* (Rudolphi, 1819) and *M. papillosus*, Van Cleave, 1916 and two new species *M. amini* from *Myiarchus ferox* (Gmelin, 1798) and *M. ayeri* from *Pitangus sulfuratus* Linneaus, 1776, *Agelaioides badius* (Vieillot, 1819), *Arremon flavirostris* (Swainson, 1830), *Furnarius cristatus* Burmeister, 1888, *F. rufus* (Gmelin, 1788) and *Zonotrichia capensis* (Statius Mueller, 1776) are reported from Paraguay for the first time. An additional putative new species could not be described fully because of insufficient material. A more complete description of *M. micracanthus* is given. The new species are distinguished from congeners principally by proboscis armature and hook size but also by body size, lemnisci length and testis size. Acanthocephalans, Gigantorhynchidae from bird hosts, *Mediorhynchus* spp. that could not be fully identified, are listed.

Keywords: Parasite - Acanthocephala - Gigantorhynchidae - *Mediorhynchus* - South America - Paraguay - birds.

INTRODUCTION

The Acanthocephala from South American birds are not well known and there have been no records of the genus *Mediorhynchus* (Gigantorhynchidae) from Paraguay. Elsewhere in South America the genus is known from a small number of reports. Seven species of *Mediorhynchus* from South America were discussed, by Schmidt & Kuntz (1977), in their revision of the genus. These authors accepted four species, *M. emberizae* Travassos, 1924 from Brazil, *M. micracanthus* (Rudolphi, 1819) a cosmopolitan species, including Brazilian localities (Travassos, 1924; Machado Filho, 1940), *M. mirabilis* (de Marval, 1905) probably from a Neotropical locality because the host is given as a *Vultur* sp. and *M. oswaldocruzi* Travassos, 1923 from Brazil, as valid species. The other three, *M. pintoi* Travassos, 1923, *M. tangrae* (Rudolphi, 1918) and *M. vaginatus* (Diesing, 1951), all from Brazil, were not included in their key; the first because it was described only from a fragmentary female and other two because they were unrecognizable. Subsequently Magalhães-Pinto *et al.* (2006) reexamined the type specimen of *M. pintoi* but were unable to add to the

description, *Mediorhynchus emberizae* was reported from the red cowed cardinal, *Paroaria dominicana* (Linnaeus, 1758) and *Mediorhynchus* sp. from the red crested cardinal, *P. coronata* (Miller, 1776) (Carvalho *et al.*, 2008; Mascarenhas *et al.*, 2009). An eighth species, *M. pauciuncinatus* Dollfus, 1959, described from a juvenile female from Peru is also too poorly known to be identified with certainty (Schmidt & Kuntz, 1977). Recently an additional species *M. peruensis* Moya, Martinez & Tantaleán, 2011 has been described from Peru (Moya *et al.*, 2011). *Mediorhynchus papillosus* Van Cleave, 1916, previously known only from Taiwan, the Pescadore Islands, Russia and North America was reported from Brazil (Schmidt & Kuntz, 1977; Brasil & Amato, 1992) but in this case the host was the cosmopolitan sparrow *Passer domesticus* Linnaeus, 1758. A current search of the literature suggests that the number of valid, completely described species in the genus is now 54 (Schmidt & Kuntz, 1977; Amin *et al.*, 2008; Moya *et al.*, 2011; Smales, 2011; Amin, 2013).

Between 1979 and 1996, during a series of surveys sponsored by the Muséum d'Histoire Naturelle, Geneva (MHNG) acanthocephalans, including representatives from the family Gigantorhynchidae, all species of *Mediorhynchus*, were collected. In this paper these species are documented, new hosts and geographic records are reported and new species are described.

MATERIALS AND METHODS

The birds examined included 26 individuals of 20 species from 10 families and one undetermined bird, from which gigantorhynchids were dissected. The collection localities of the hosts, with the number of hosts in parentheses, are listed by Department as follows:

Alto Parana CFAP (1). - *Boqueron* La Dorada, Pilcomayo (1); Pedro P Pena (2); Pratts Gill (1); Route Filadelfia-Teniente, Montana km 8 (1). - *Concepcion* Arroyo Trementina (1); Estrellas (1); Aquidaban (1). - *Cordillera* Tobati (1). - *Misiones* Panchito Lopez (1). - *Neembucu* General Diaz, General Diaz 2W, General Diaz N2W (3); Pilar (1). - *Paraguari* Carapegua (1). - *Presidente Hayes* Pozo Arias (3); Rio Aguary-Guazu (2); Transchaco 293 (4). - *San Pedro* Jejui (1).

On dissection all specimens were fixed with neutral buffered formalin and stored in 75% ethanol. Before microscopic examination all specimens were cleared in lactophenol or beechwood creosote to be studied as wet mounts. All measurements were made with the aid of an eyepiece micrometer and are given in micrometres unless otherwise stated. Where three or more specimens could be measured the range is given followed by the mean in parentheses. Trunk length does not include proboscis neck or bursa and trunk width was taken at the widest part; width of both the proboscis and neck were taken at their bases. Illustrations were made with the aid of a drawing tube.

The terminology for the genus *Mediorhynchus* follows Schmidt (1977) and Schmidt & Kuntz (1977). All specimens collected for this study are registered in the MHNG.

RESULTS

All the specimens examined for this study were identified as *Mediorhynchus* spp. (Gigantorhynchidae) (Table 1). Four hosts were infected with adult acantho-

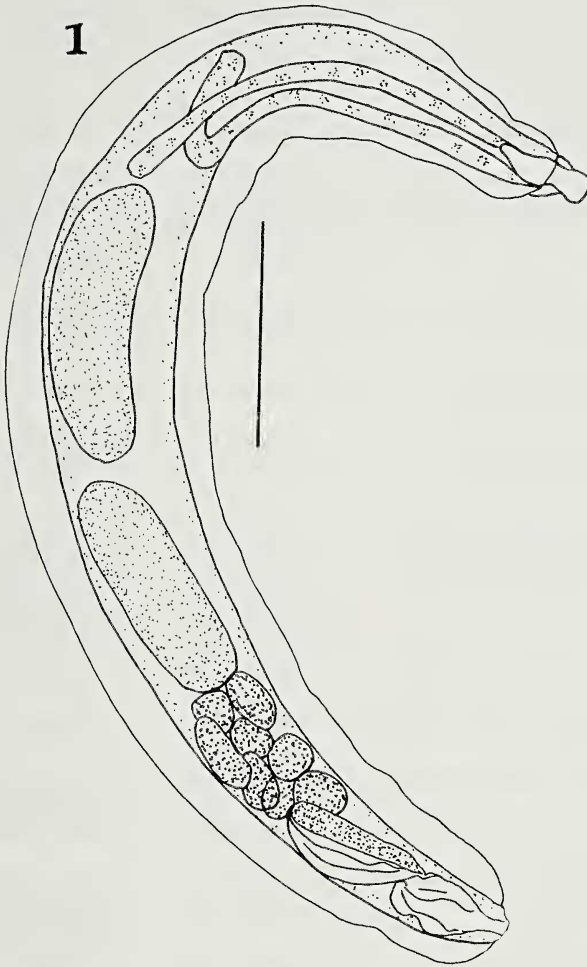


FIG. 1

Mediorhynchus sp. Male. Scale bar: 1 mm.

cephalan specimens that had damaged, missing or inverted proboscides (MHNG registration numbers INVE-38395, INVE-37405, INVE-38409, INVE-38429) that could not be identified further (Table 1). All these records are new host and locality-records.

Two males and a female, *Mediorhynchus* sp. (Fig. 1) were found in the small intestine of *Saltator similis*, d'Orbigny & Lafresne, 1837 (Cardinalidae); Paraguay, La Dorada, 01.10.1996 (MHNG-INVE-38422). Measurements were as follows: Males; trunk 7, 10 mm long, 970, 985 wide, proboscis 605, 435 long, 235, 300 wide; anterior proboscis 390, posterior proboscis 215 long; neck 130, 190 long, 435, 400 wide, pro-

TABLE 1. Acanthocephala: Gigantorhynchidae from 26 bird hosts from Paraguay, South America, collected between 1979 and 1996

Host	host field no. Py	Locality
Passiferiformes		
Cardinalidae		
<i>Saltator similis</i> d'Orbigny & Lafresne, 1837	8927	La Dorada, Pilcomayo
Emberezidae		
<i>Arremon flavirostris</i> Swainson, 1838	2386	Pilar
<i>Paroaria capitata</i> (d'Orbigny & Lafresne, 1837)	5665	Rio Aguary-Guazu
	5667	Rio Aguary-Guazu
<i>Zonotrichia capensis</i> (Statius Mueller, 1776)	7472	General Diaz 2W
Furnariidae		
<i>Furnarius cristatus</i> Burmeister, 1888	6663	Transchaco 293
<i>Furnarius rufus</i> (Gmelin, 1788)	3819	Tobati
Hirundinidae		
<i>Progne chalybea</i> (Gmelin, 1789)	4212	Jejui
Icteridae		
<i>Agelaioides badius</i> (Vieillot, 1819)	8846	Pozo Arias
<i>Cacicus solitarius</i> Vieillot, 1816	4787	Pedro P Pena
<i>Cacicus chryopterus</i> (Vigors, 1825)	6675	Transchaco 293
<i>Chrysomus cyanopus</i> (Vieillot, 1819)	8272	General Diaz
<i>Icterus cayanensis</i> Linnaeus, 1776	6532	Aquidiban
<i>Molothrus bonariensis</i> (Gmelin, 1789)	6672	Transchaco 293
	7474	General Diaz N2W
<i>Psarocolius decumanus</i> (Pallas, 1769)	0188	Estrellas
Thraupidae		
<i>Trichothraupis melanops</i> (Vieillot, 1818)	3655	CFAP
Turdidae		
<i>Turdus amaurochalinus</i> Cabanis, 1850	4781	Pedro P Pena
	8047	Arroyo Trementina
	8831	Pozo Arias
Tyrannidae		
<i>Myiarchus ferox</i> (Gmelin, 1789)	2120	Carapegua
	8669	Rte Filadelfia-Teniente Montana km 8
		Panchito Lopez
<i>Pitangus sulphuratus</i> Linnaeus, 1776	2514	
Vireonidae		
<i>Cyclarhis gujanensis</i> (Gmelin, 1789)	4139	Pratts Gill
Piciformes		
Picidae		
<i>Picoides</i> sp.	8825	Pozo Arias
Undetermined bird	6685	Transchaco 293

boscis receptacle 300, 400 long, 168 wide, lemnisci extending to the anterior testis, 2590, 2545 long, 150 wide; the testes, anterior 1275, 1275 long, 390, 425 wide and posterior 1410, 1460 long, 375, 440 wide, cement glands 308-425 wide and Saeftigen's pouch 645, 670 long. The armature of the proboscis was difficult to establish with any certainty but may have been 24 rows of 4-6 hooks and 32 irregular rows of spines. Although this combination of armature and morphometrics is not similar to any species of *Mediorhynchus* presently known, additional specimens with proboscides in sound condition are needed to confirm the identity of these specimens.

Dept	Geographical coordinates	Acanthocephalan
Boqueron	-27.71 -62.15	<i>Mediorhynchus</i> sp., 2 males, 1 female
Neembucu	-26.87 -58.38	<i>Mediorhynchus ayeri</i> sp. n.
Pte Hayes	-24.58 -58.03	<i>Mediorhynchus micracanthus</i> (Rudolphi, 1819)
Pte Hayes	-24.58 -58.03	<i>Mediorhynchus micracanthus</i>
Neembucu	-27.77 -57.83	<i>Mediorhynchus ayeri</i>
Pte Hayes	-23.40 -58.99	<i>Mediorhynchus ayeri</i>
Cordillera	-25.28 -57.09	<i>Mediorhynchus ayeri</i>
San Pedro	-14.21 -57.15	<i>Mediorhynchus emberizae</i> (Rudolphi, 1819)
Pte Hayes	-23.65 -60.10	<i>Mediorhynchus ayeri</i>
Boqueron	-22.45 -62.35	<i>Mediorhynchus</i> sp., 1 male, 1 female juveniles, proboscides inverted
Pte Hayes	-23.40 -58.99	<i>Mediorhynchus emberizae</i>
Neembucu	-27.77 -57.83	<i>Mediorhynchus</i> sp., 1 female, proboscis completely inverted
Concepcion	-23.11 -57.62	<i>Mediorhynchus</i> sp., 1 male, proboscis and proboscis receptacle damaged
Pte Hayes	-23.40 -58.99	<i>Mediorhynchus micracanthus</i>
	-27.77 -57.83	<i>Mediorhynchus</i> sp., 1 female no proboscis
Concepcion	-22.11 -67.72	<i>Mediorhynchus micracanthus</i>
Alto Parana	-25.50 -54.70	<i>Mediorhynchus emberizae</i>
Boqueron	-22.45 -62.35	<i>Mediorhynchus papillosus</i> Van Cleave, 1916
Concepcion	-22.82 -56.70	<i>Mediorhynchus papillosus</i>
Pte Hayes	-23.65 -60.10	<i>Mediorhynchus papillosus</i>
Paraguari	-25.80 -57.23	<i>Mediorhynchus amini</i> sp. n.
Boqueron	-22.30 -60.06	<i>Mediorhynchus amini</i>
Misiones	-27.40 -57.27	<i>Mediorhynchus ayeri</i>
Boqueron	-22.56 -61.71	<i>Mediorhynchus emberizae</i>
Pte Hayes	-23.65 -60.10	<i>Mediorhynchus emberizae</i>
Pte Hayes	-23.40 -58.99	<i>Mediorhynchus micracanthus</i>

Mediorhynchus emberizae (Rudolphi, 1819)

MATERIAL EXAMINED: MHNG-INVE-38392; 2 males, 2 females, small intestine, *Cacicus chrysopterus* (Vigors, 1825) (Icteridae), Paraguay, Transchaco 293, 03.11.1988. – MHNG-INVE-38419; 1 male, small intestine, *Picoides* sp. (Picidae), Paraguay, Pozo Arias, 11.08.1996. – MHNG-INVE-38440; 2 females, small intestine, *Cyclarhis gujanensis* (Gmelin, 1789) (Virionidae), Paraguay, Pratts Gill, 01.08.1985. – MHNG-INVE-38449; 4 females, small intestine, *Trichothraupis melanops* (Vieillot, 1818) (Thraupidae), Paraguay, CFAP, 10.08.1984. – MHNG-INVE-38452; pieces of 2 males, 3 females, small intestine, *Progne chalybea* (Gmelin, 1789) (Hirundinidae), Paraguay, Jejui, 08.10.1985.

COMMENTS: The proboscis armature, 20-22 rows of 5-6 hooks and 2-3 spines and comparative morphometrics were consistent with these specimens being *M. emberizae* (see Table 2). The geographical distribution of *M. emberizae* has been extended from Brazil to Paraguay and the host range from *Paroaria dominicana*, *Ostinops decumanus*, *Brachispiza capensis*, *Cacicus haemorhous*, *Cacicus* sp., *Heleodytes unicolor*, *Molothrus bonariensis*, *Pseudochloris cirtina* and *Rhamphocoelus* sp. (Travassos, 1924; Carvalho *et al.*, 2008) to the passeriforms *Cacicus chrysopterus*, *Cyclarhis gujanensis*, *Trichothraupis melanops*, *Progne chalybea* and the piciform *Picoides* sp.

***Mediorhynchus micracanthus* (Rudolphi, 1819)**

Figs 2-8

MATERIAL EXAMINED: MHNG-INVE-38383 male, small intestine *Paroaria capitata* (d'Orbigny & Lafresne, 1837) (Emberizidae), Paraguay, Rio Aguay-Guazu, 22.10.1987. – MHNG-INVE-38391, INVE-38382; 1 male, 2 pieces females, small intestine, *Molothrus bonariensis* (Gmelin, 1789) (Icteridae), Paraguay, Transchaco 293, 03.11.1988. – MHNG-INVE-3851; 3 females, small intestine, *Psarocolius decumanus* (Pallas, 1769) (Icteridae), Paraguay, Estrellas, 16.10.1979. – MHNG-INVE-38394; 2 pieces male, 1 female, small intestine, undetermined bird, Paraguay, Transchaco 293, 04.11.1988.

REVISED DESCRIPTION

General: (based on 1 male, 3 females and 5 pieces males, 4 pieces females, including anterior and posterior ends) Robust worms, medium sized, trunk cylindrical, thick, with heavy shoulders, slightly tapering at posterior end, aspinose (Figs 2, 5). Main lacunar canals with regular lateral branches. Proboscis conical, truncated, in 2 parts; anterior proboscis with rooted hooks, posterior proboscis wider with rootless spines (Fig 5). Hook roots flask shaped with rounded larger posterior ends with scalloped outer edges, spines slender with stubby basal discs (Fig. 3). Proboscis armature similar in both sexes, 16-18 rows of 4-5 hooks, 2-3 spines. Neck unarmed, conical, widest at junction with broader trunk. Proboscis receptacle attached anteriorly at junction between anterior and posterior proboscis, with cerebral ganglion near mid region, about twice as long as proboscis (Fig. 7). Lemnisci long, slender, equal, inserted at base of neck (Fig. 2). Genital pore male sub terminal; female terminal without papillae.

Male: (based on 1 complete specimen, 1 anterior end, 2 posterior ends) Trunk 12.5 mm long 0.5 mm wide. Proboscis 560, 460 long, 490, 280 wide; anterior proboscis 360, 295 long, posterior proboscis 200, 165 long. Hook lengths, sequence of 1 longitudinal row measured from anterior 10, 11, 20, 20, 15; spines 5 long. Neck 80, 140 long, 480, 300 wide. Proboscis receptacle 950, 490 long, 330 wide. Lemnisci extend to anterior testis, 2890, 3560 long 110 wide. Testes oblong, tandem, contiguous, in mid third of trunk; anterior testis 1660, 1870 long, 700, 595, wide; posterior testis 2000, 1615 long, 750, 500 wide. Cement glands 8 globular, in cluster, each gland 268- 350 (302) wide. Saeftigen's pouch 1000, 765, 500 long (Fig. 4).

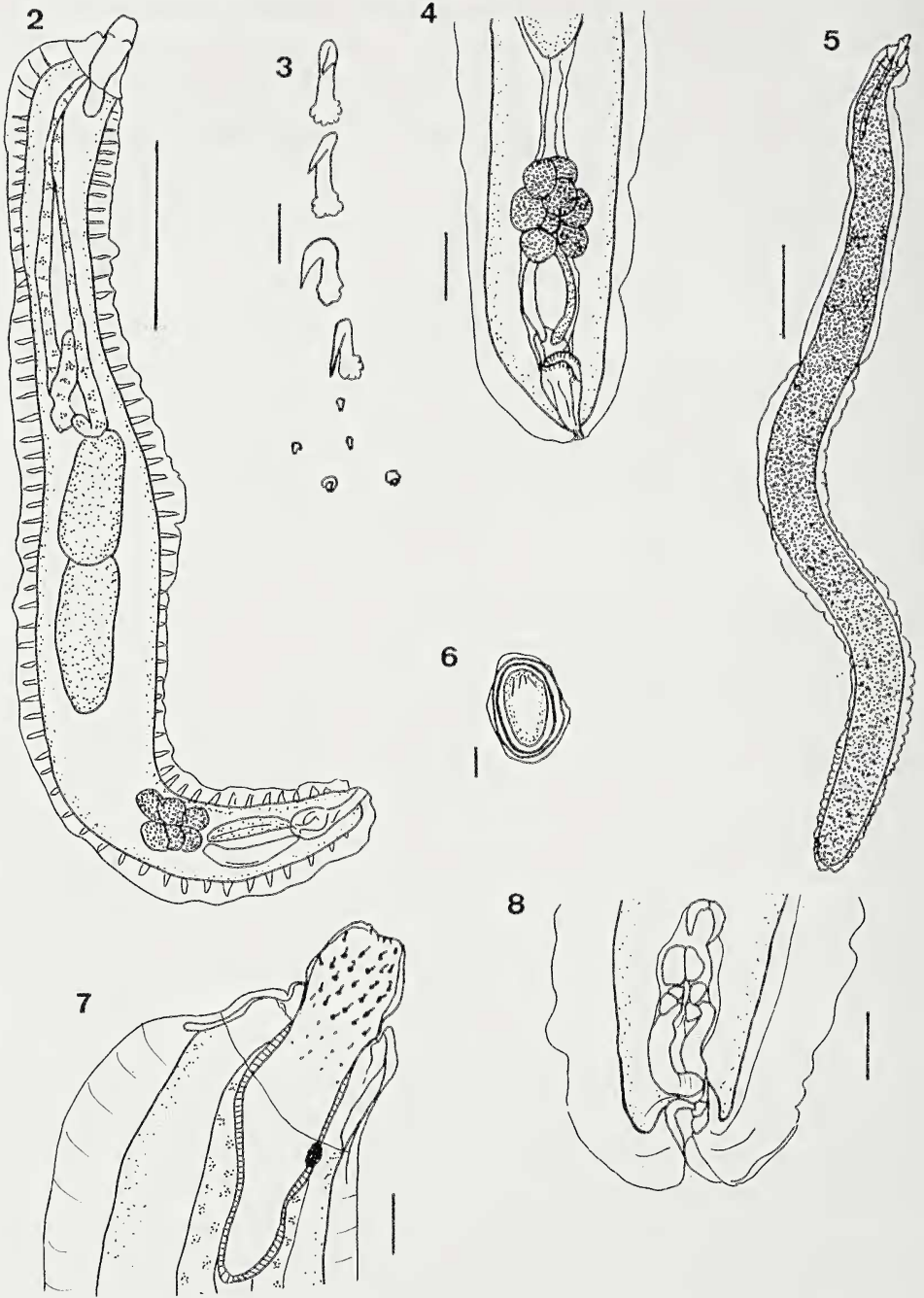
Female: (based on 3 complete specimens, 2 anterior ends) Trunk 20-21 (20.33) mm long, 1360-1530 (1457) wide. Proboscis 350, 390 long, 335 wide; anterior proboscis 240, 280, posterior proboscis 110, 120. Hook lengths, sequence of 1 longitudinal row measured from anterior 20.5, 24, 22, 24; spines 5-7 long. Neck 120,

TABLE 2. Comparative measurements for *Mediorhynchus emberizae* (Rudolphi, 1819) and *M. micracanthus* (Rudolphi, 1819).

	<i>M. emberizae</i>	<i>M. emberizae</i>	<i>M. micracanthus</i> / <i>M. armenicus</i>	<i>M. micra-</i> <i>canthus</i>
Reference	Travassos, 1924; Petrochenko, 1958	this study	Petrochenko, 1958	this study
Male				
trunk length mm	6-8	6-8	5.8-20	12.5
width	1	1.2-1.3	0.53-0.93	0.5
largest hook length	30-35	30-31	26-35	20-25
proboscis length	370-400	295-380	600-630	460-560
width at base	300	300-400	310-390	280-490
neck length		200-220		80-140
width		410-470		300-480
proboscis receptacle				
length	400	350-705	700-800	490-950
width		180-440	170	330
lemnisci length	2000-5000	2805-5600	2040-2900	2890-3560
Testis, anterior length	1200	1020-1350	1500-2100	1660-1870
width	400	375-425	500	595-700
posterior length	1400	1375-2210		1615-2000
width	500	375-544		500-750
cement glands		270-500	400-500	268-350
Saeftigen's pouch		545-765		500-1000
Female				
trunk length mm	20-55	8-25	20	20-21
width mm	1.0-1.5	0.86-2.2	0.75	1.4-1.5
proboscis length		410-765	420	350-390
width at base		280-510	355	335
neck length		265-725	175	120-200
width		435-670		470-535
proboscis receptacle				
length		605-2295	650	670-870
width		200-380		210-510
lemnisci	4000-5000	4080-9350	3200	2250-5610
reproductive tract				
length	830	805-1055		500-550
egg length	60-68	49.5-56.0	50	47.6-59.3
width	40-50	26.5-36.5	26	26.4-39.6

200 long, 535, 470 wide. Proboscis receptacle 670-871 (737) long, 210-510 (360) wide. Lemnisci 2250 - 5610 (3583) long, 100, 200 wide. Reproductive tract, 500, 550 long, about 25-26% trunk length (Fig. 8). Eggs ovoid, with concentric shells and thin outer membrane, 47.6-59.4 (53.6) long, 26.4-39.6 (32.8) wide (Fig. 6).

COMMENTS: A more comprehensive description of *M. micracanthus* is given here because the most recent redescription (Petrochenko, 1958) is rather brief. The proboscis armature and hook size of the specimens from Paraguay, 16-18 longitudinal rows of 4-5 hooks up to 25 long, and 2- 3 spines is consistent with the description of the proboscis of *M. micracanthus* as given by Petrochenko (1958, fig. 136), although the figure is difficult to interpret. Further, the specimens, total hook number 64-90, fall out as *M. micracanthus*, total hook number 64-96, in the key of Schmidt & Kuntz



FIGS 2-8

Mediorhynchus micracanthus (Rudolphi, 1819). (2) Male. (3) Proboscis hooks and spines, longitudinal row. (4) Posterior end male. (5) Gravid female. (6) Egg. (7) Anterior end female. (8) Posterior end female. Scale bars: 2, 5, 1 mm; 3, 25 μ m; 4, 7, 8, 200 μ m; 6, 12.5 μ m.

(1977). The descriptions of the proboscis armature of *M. micracanthus* and its synonym, *M. armenicus* Petrochenko, 1958 are given in spiral rows by Petrochenko (1958). An analysis by Schmidt & Kuntz (1977) demonstrated that although the proboscis hook patterns of species of *Mediorhynchus* may appear irregular basically they are arranged in longitudinal rows. Accordingly they reexamined all known species and converted the hook formulae to longitudinal rows. This revealed the synonymy of *M. micracanthus* and *M. armenicus* to which was assigned the hook formula of 20-24 rows of 3-4 hooks. Therefore the specimens from Paraguay can be identified as *M. micracanthus*. The morphology and morphometrics of the specimens from Paraguay were also consistent with those of *M. micracanthus* syn *M. armenicus* (Petrochenko, 1958) (Table 2).

The geographical distribution of *M. micracanthus* in South America can now, therefore, be extended from Brazil to Paraguay and the host range to include *Paroaria capitata*, *Molothrus bonariensis*, *Psarocolius decumanus* as well as the undetermined bird species.

Mediorhynchus papillosus Van Cleave, 1916

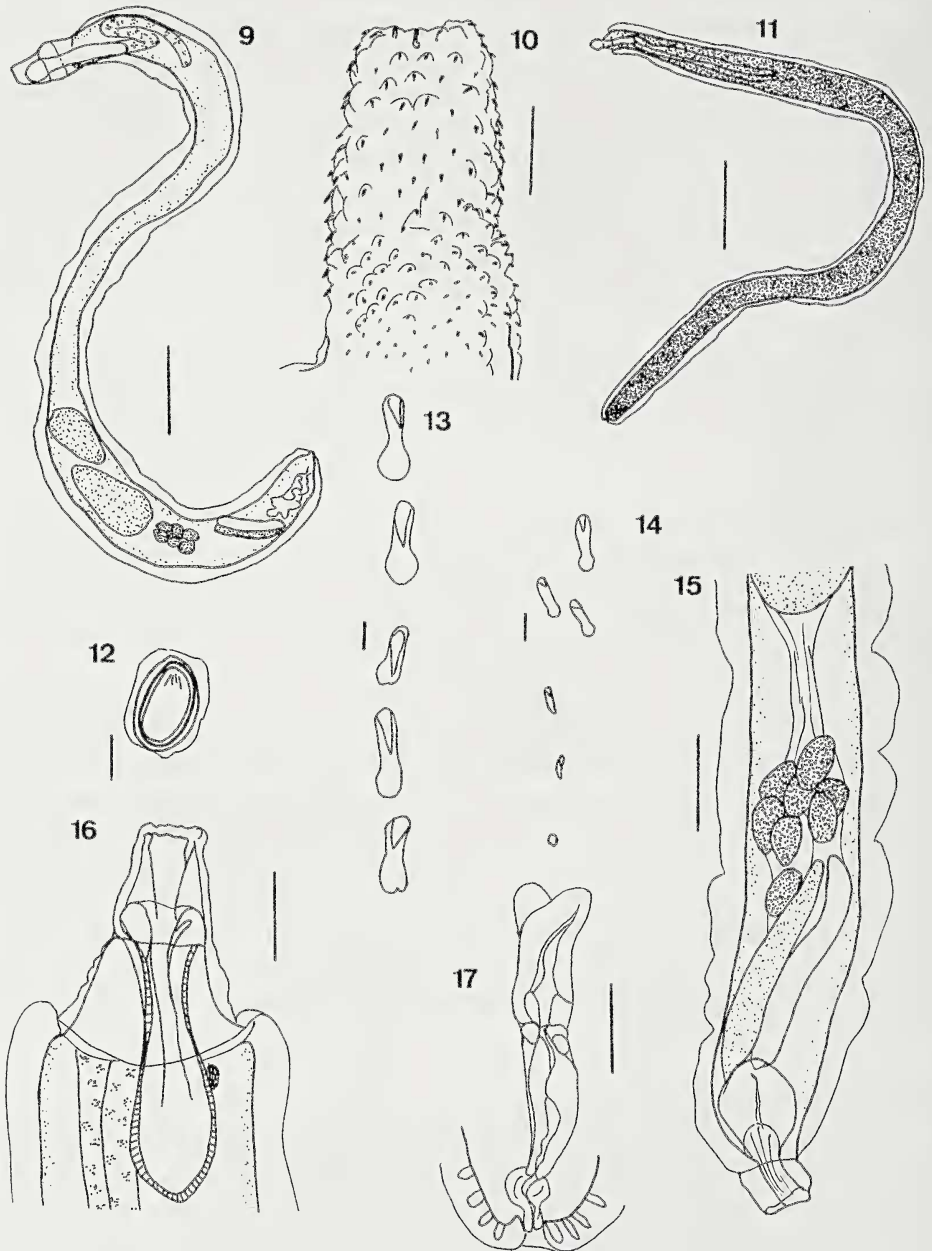
MATERIAL EXAMINED: MHNG-INVE-38420, 1 male, 1 female, pieces of worm, small intestine, *Turdus amaurochalinus*, Cabanis, 1850 (Turdidae), Paraguay, Pozo Arias, 11.08.1996. – MHNG-INVE-38407, 1 juvenile female, small intestine, *Turdus amaurochalinus*, Cabanis, 1850, Paraguay, Arroyo Trementina, 12.10.1991. – MHNG-INVE-38454, 1 female, small intestine, *Turdus amaurochalinus*, Cabanis, 1850, Paraguay, Pedro P Pena, 8.10.1986.

COMMENTS: The morphology of the proboscis, with cuticular folds, a proboscis armature of 24 rows of 4-5 hooks and 30-34 rows of 4 spines, largest hooks 30, is consistent with that of *M. papillosus* (see Amin & Dailey, 1998). When compared with the populations of *M. papillosus* noted by Amin & Dailey (1989) measurements of all except the lemnisci fall within the variability listed. The lemnisci of the Paraguayan male are longer than the trunk, as has been previously described only for juvenile males, but this difference is congruent with the morphological variability found in different populations of *M. papillosus* (Amin & Dailey, 1989). In South America *M. papillosus* was known only from the cosmopolitan sparrow, *P. domesticus* from Brazil. The geographical distribution is now extended to Paraguay and the host range to include *T. amaurochalinus*.

Mediorhynchus amini sp. n. Figs 9-17

MATERIAL EXAMINED: MHNG-INVE-84833; holotype male, small intestine, *Myiarchus ferox* (Gmelin, 1789) (Tyrannidae), Paraguay, Route Filadelfia-Teniente, Montana 8 km, 23.11.1993. – MHNG-INVE-84844; paratype (allotype) female, small intestine, *Myiarchus ferox* (Gmelin, 1789), Paraguay, Filadelfia-Teniente, Montana 8 km, 23.11.1993. – MHNG-INVE-38411; 1 male, 2 females, 7 pieces of female, paratypes, small intestine, *Myiarchus ferox* (Gmelin, 1789), Paraguay, Filadelfia-Teniente, Montana 8 km, 23.11.1993. – MHNG-INVE-38434; 1 female voucher specimen, small intestine, *Myiarchus ferox* (Gmelin, 1789), Carapegua, 10.10.1982.

ETYMOLOGY: The species is named to recognize the contribution of Dr Omar Amin to acanthocephalan taxonomy.



FIGS 9-17

Mediorhynchus amini sp. n. (9) Male. (10) Proboscis, female, showing armature. (11) Gravid female. (12) Proboscis, female, showing armature. (13) Proboscis hooks, longitudinal row. (14) Proboscis spines with slender or discoid roots. (15) Posterior end male. (16) Anterior end, female. (17) Posterior end female. Scale bars: 9, 400 μ m; 10, 150 μ m; 11, 1 mm; 12, 25 μ m; 13, 14, 6 μ m; 15, 300 μ m; 16, 17, 200 μ m;.

DESCRIPTION

General: (based on 2 males, 4 females) Robust worms, medium sized, trunk cylindrical, thick, with shoulders, posterior third expanded in male, slightly tapering at posterior end in female, aspinose (Figs 9, 11). Main lacunar canals with regular lateral branches. Proboscis conical, truncated, in 2 parts; anterior proboscis with rooted hooks, posterior proboscis wider, with spines; hooks and spines embedded in cuticular papillae when proboscis not fully extended. Roots of hooks flask shaped with rounded larger posterior ends, spines slender with either reduced slender flask shaped roots or basal discs. Proboscis armature similar in both sexes, 22-24 rows of 5-6 hooks, about same number of irregular rows 5-6 spines (Fig. 10). Hook lengths, sequence of 2 longitudinal rows measured from anterior, 7 -; 18, 18; 16.5, 16; 22, 12; 13, 12; 13, 8 long; spines 5, 10 long (Figs 13, 14). Neck unarmed, conical, widest at junction with broader trunk. Proboscis receptacle attached anteriorly at junction between anterior and posterior proboscis, about twice as long as proboscis, with cerebral ganglion near mid region (Fig 16). Lemnisci long, slender, equal, inserted at base of neck (Fig. 9). Genital pore, male and female, terminal.

Male: (Based on 2 specimens) Trunk 9.1, 11 mm long, 680, 850 wide. Proboscis 470 long, 370 wide; anterior proboscis 290, posterior proboscis 180. Neck 120 long, 300 wide. Proboscis receptacle 850 long, 320 at widest part. Lemnisci 2800 long, 100 wide. Testes ovoid, tandem, contiguous, in posterior third of trunk; anterior testis 680 long, 305 wide; posterior testis 985 long, 440 wide. Cement glands 8 globular, in cluster, each about 100 wide. Saefftigen's pouch 600 long (Fig. 15).

Female: (based on 4 specimens) Trunk 15-22 (18.75) mm long, 670-1105 (826) wide. Proboscis 415-770 (630) long; anterior proboscis 230-380 (350) long, posterior proboscis 185-385 (373) long; 315-375 (337) wide. Neck 105-170 (150) long, 370-450 (423) wide. Proboscis receptacle 670-750 (707) long, 215-220 (217) wide. Lemnisci 7500 (1 measurement) long, 110 wide. Reproductive tract, 500, 600 long (Fig. 17). Eggs ovoid, with concentric shells and thin outer membrane; 49.5-56.1 (52.8) long, 26.4-29.7 (28.0) wide (Fig. 12).

COMMENTS: *Mediorhynchus amini* sp. n. demonstrates the characters of the genus as described by Van Cleave (1916) and discussed by Schmidt & Kuntz (1977) and Amin & Dailey (1998). None of the species of *Mediorhynchus* described to date have spines with markedly reduced, but typically shaped, roots on the posterior proboscis. Consideration of the key of Schmidt & Kuntz (1977) indicated that *M. amini* with a proboscis armature of 22-24 rows of 5-6 hooks, largest hooks 18-22 was most similar to *M. corcoracis* Johnston & Edmonds, 1951 with 22 rows of 5-6 hooks, largest hooks 14-18. *Mediorhynchus amini* further differs from *M. corcoracis* in having about the same number of rows of 5-6 spines compared with 40 rows of 4-5 spines. *Mediorhynchus amini*, is a much smaller worm (males 9-11, compared with 25-33 mm long) with smaller testes (680-985 compared with 1600-2600) than *M. corcoracis* (Johnston & Edmonds, 1951).

Of the species listed or described by Amin *et al.* (2008) since the key was developed; namely *M. channapettae* George & Nadakal, 1984, *M. fatimaae*, Khan, Bilqees & Muti-ur-Rehman, 2004, *M. lophurae* Wang, 1966, *M. mariae* George &

Nadakal, 1984, *M. mattei*, Marchand & Vassiliades, 1982, *M. nickoli* Khan, Bilqees & Muti-ur-Rehman, 2004, *M. rajasthanensis* Gupta, 1976 and *M. lanius* Amin, Ha & Heckman, 2008 only *M. lanius* with 22 rows of 6-7 hooks and 29 rows of 4-5 spines has a proboscis hook formula approaching that of *M. amini*. *Mediorhynchus amini*, however, further differs from *M. lanius* in being a smaller worm (males 9-11 compared with 28.75 mm long) and having smaller hooks and spines (hooks 7-18, spines 5-10 long, compared with hooks 35-45, spines 30-37 long) (Gupta, 1976; Marchand & Vassiliades, 1982; George & Nadakal, 1984; Khan *et al.*, 2004; Amin *et al.*, 2008).

An additional 7 species are known including; *M. colluricinclae* Smales, 2002, (proboscis armature 26-28 rows of 7-8 hooks and 36-38 rows of 3-8 spines), *M. cisticolae* Smales, 2011 (proboscis armature 20-22 rows of 5-6 hooks and 26 rows of 2-3 spines), *M. gibsoni* Bilqees, Khan, Khatoon & Khatoon, 2007 (proboscis armature 25 rows of 8-12 hooks and 10 rows of 8-16 spines), *M. spinaepaucitas* Smales, 2011 (proboscis armature 20-22 rows of 4-5 hooks and 30 rows of 4-5 spines), and *M. turdi* Smales, 2011 (proboscis armature 24-28 rows of 7-9 hooks and 35-40 rows of 3-5 spines) (Bilqees *et al.*, 2007; Smales, 2011). None of the above species have proboscis armature similar to that of *M. amini*. *Mediorhynchus peruensis* (proboscis armature 14-16 rows of 4-6 hooks and a total of 104-120 spines) (Moya *et al.*, 2011) is the only species to have been described from South America since Amin *et al.* (2008) reviewed the genus. The proboscis armature of *M. amini* (22-24 rows of 5-6 hooks and 5-6 spines), however, does not resemble that of *M. peruensis* (Moya *et al.*, 2011).

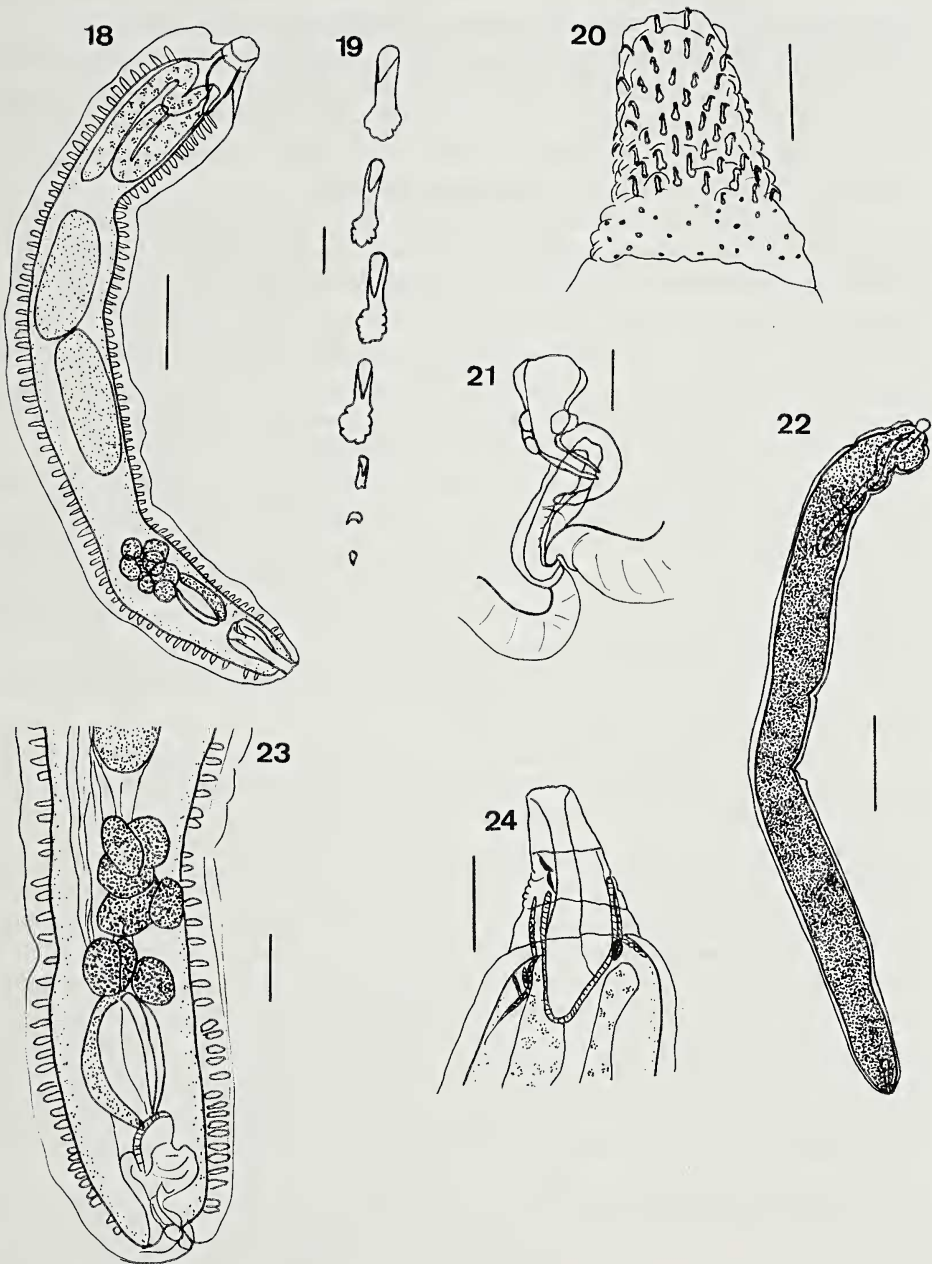
Mediorhynchus ayeri sp. n. Figs 18-24

MATERIAL EXAMINED: MHNG-INVE-84848; holotype male, small intestine, *Pitangus sulfuratus* Linnaeus, 1776 (Tyrannidae), Paraguay, Panchito Lopez, 24.10.1982. – MHNG-INVE-84849; paratype (allotype) female, small intestine, *Pitangus sulfuratus* Linnaeus, 1776, Paraguay, Panchito Lopez, 24.10.1982. – MHNG-INVE-38446; 1 cystacanth, 1 male, 4 females, paratypes, small intestine, *Pitangus sulfuratus* Linnaeus, 1776, Paraguay, Panchito Lopez, 24.10.1982. – MHNG-INVE-38421; 2 females, voucher specimens, small intestine, *Agelaioides badius* (Vieillot, 1819) (Icteridae), Paraguay, Pozo Arias, 12.08.1996. – MHNG-INVE-38404; 2 females, voucher specimens, small intestine, *Zonotrichia capensis* (Statius Mueller, 1776) (Emberizidae), Paraguay, General Diaz, 2W, 19.10.1989. – MHNG-INVE-38445; 3 males, voucher specimens, small intestine, *Arremon flavirostris* Swainson, 1830 (Emberizidae), Paraguay, Pilar, 19.10.1982. – MHNG-INVE-38442; 2 males, voucher specimens, small intestine, *Furnarius rufus* (Gmelin, 1788) (Furnariidae), Paraguay, Tobati, 20.03.1985. – MHNG-INVE-38390; 2 males, 2 pieces worm, small intestine, *Furnarius cristatus* Burmeister (Furnariidae), 1888, Paraguay, Transchaco 293, 03.11.1988.

ETYMOLOGY: This species is named in honour of Jacques Ayer, the director of the Natural History Museum, Geneva.

DESCRIPTION

General: (based on 9 males and 4 females) Relatively small robust worms, trunk more or less cylindrical, body wall thick, aspinose (Figs 18, 22). Main lacunar canals with regular lateral branches. Proboscis conical, truncated, in 2 parts; anterior proboscis with rooted hooks, posterior proboscis wider with spines (Fig. 20); Roots of hooks flask shaped with rounded larger posterior ends with scalloped edges, anterior spines with much reduced flask shaped roots, posterior spines with basal discs



FIGS 18-24

Mediorhynchus ayeri sp. n. (18) Male. (19) Proboscis hooks, longitudinal row showing hooks 1-4, and spines. (20) Proboscis armature, male. (21) Posterior end, female. (22) Mature female with germ cell balls. (23) posterior end male. (24) Anterior end, male. Scale bars: 18, 400 μ m; 19, 12.5 μ m; 20, 21, 100 μ m; 22, 1 mm; 23, 24, 200 μ m.

(Fig. 19). Proboscis armature similar in both sexes, 18-22 rows of 4-5 hooks, about same number of irregular rows 2-3, usually 2 spines; male, longest hooks 20, 21, 22, shortest hooks 15, 15, 19; spines 5, 10 long. Neck unarmed, conical, widest at junction with broader trunk. Proboscis receptacle attached anteriorly at junction between anterior and posterior proboscis, with cerebral ganglion near mid region (Fig. 24). Lemnisci long, slender, equal, inserted at base of neck, extend beyond anterior testis in male (Fig. 18). Genital pore, male and female, terminal.

Male: (Based on 9 specimens) Trunk 4-7 (4.9) mm long 440-970 (650) wide. Proboscis 265-535 (424) long, 230-605 (347) wide; anterior proboscis 160-385 (247), posterior proboscis 95-150 (129). Neck 20-200 (126) long, 230-770 (443) wide. Proboscis receptacle 350-680 (504) long, 135-235 (187) wide. Lemnisci 1535-3145 (2150) long, 80-150 (112.9) wide. Testes ovoid, tandem, usually contiguous, in mid third of trunk; anterior testis 850-1190 (1059) long, 180-610 (322) wide; posterior testis 765-1375 (1080) long, 180-680 (368) wide. Cement glands 8 globular, in cluster, 175-460 (279) in diameter. Saeftigen's pouch 375-690 (500) long (Fig. 23).

Female: (based on 4 specimens, none with proboscis fully extended) Trunk 15-22 (18.5) mm long, 765-1020 (850) wide. Proboscis 360-535 (448) wide; lengths of anterior and posterior proboscis not determined. Neck 85-135 (110) long, 435-440 (438) wide. Proboscis receptacle 500-800 (650) long, 265-295 (285) wide. Lemnisci 2940-3095 (3018) long, 150 wide. Reproductive tract, 300-650 (484) long, about 20-29.5% of trunk length (Fig. 21). Eggs not seen.

Cystacanth: (single specimen) proboscis 330 long, 247.5 wide; anterior proboscis 220, posterior proboscis 110 long.

COMMENTS: *Mediorhynchus ayeri* sp. n. demonstrates the characters of the genus as described by Van Cleave (1916) and discussed by Schmidt & Kuntz (1977) and Amin & Dailey (1998). Consideration of the key of Schmidt & Kuntz (1977) indicated that *M. ayeri* with a proboscis armature of 18-22 rows of 4-5 hooks, was closest to *M. gallinarum* (Bhalerao, 1937) which also has a proboscis armature of 18-22 rows of 4-5 hooks. The proboscis armature of *M. ayeri*, however, differs from that of *M. gallinarum* in the number of rows of spines (about 22-24 compared with 25-30 rows) the number of spines in each row (2-3, usually 2, compared with 2-6) and the size of the hooks (largest hooks 20-22 compared with 40-70). Moreover *M. ayeri*, a smaller worm (males 4-7mm), is found in passerines from South America whereas *M. gallinarum*, a larger worm (males 9-26), is found in galliforms across India and Southeast Asia (Amin *et al.*, 2013). Neither the species listed or described by Amin *et al.* (2008) nor the species described since 2008, as listed above, have proboscis armature similar to that of *M. ayeri*.

Of the species previously known from South America *M. ayeri* comes closest to *M. emberizae*, which has a proboscis armature of 20-22 rows of 5-6 hooks and 2-3, usually 3 spines as compared with 18-22 rows of 4-5 hooks and 2-3, usually 2 spines (Petrochenko, 1958). *Mediorhynchus ayeri* further differs from *M. emberizae* in having smaller hooks (largest hooks 20-22 compared with 30-35), smaller testes (765-1377 compared with 1020-2210) shorter lemnisci in the female (2940-3095 compared with 3700-9350) and a shorter female reproductive tract (300-650 compared with 805-1055).

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